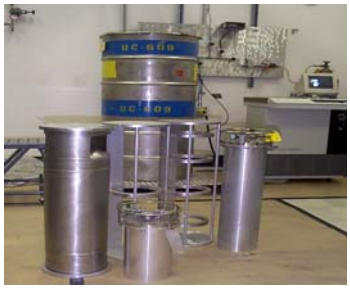
DOE Certified Radioactive Materials Transportation Packagings















EM Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

DOE Packaging Certification Program

DOE Certified Radioactive Materials Transportation Packagings

The Packaging Certification Program, or PCP, of the U.S. Department of Energy's Environmental Management, Office of Packaging and Transportation (EM-63) ensures the safety of packagings for hazardous materials to support vital Department of Energy missions across the complex, as well as risk reduction, cleanup, and closure activities.

DOE is at a critical juncture in their infrastructure that severely challenges the ability of packaging radioactive materials for transportation.

October 1, 2008 - All Type B( ), 6M, 6L, 20WC, 21WC and other DOT specification packages are no longer permitted to be transported by law. Numerous new packagings will have to be designed and certified to replace the retired packagings.

EM will have more complicated radioactive materials to ship because of site de-inventory of the final materials that cannot be shipped in standard certified packagings.

Over the last decade there has been a decrease in DOE's packaging core competencies. Unstable and insufficient funding for packaging certification projects has led to infrastructure problems and impacted mission-critical programs and projects.

Technology related to packaging is rapidly advancing at the same time when many of the old packaging designs for legacy materials are being phased out. PCP has been fostering new packaging technologies — including the development of radiofrequency identification, or RFID tracking system since 2005 — that helps ensure safety, safeguard, security in nuclear materials management and advance DOE goals.

About Packaging

Packaging refers to a container and all accompanying components or materials necessary to perform its containment function. Packagings used by DOE for hazardous materials shipments are either certified to meet specific performance requirements or built to specifications described in Department of Transportation (DOT) hazardous materials regulations (Title 49 of the Code of Federal Regulations [CFR] Subchapter C).

For relatively low-level radioactive materials, DOT Specification Type A packagings are used. For fissile materials in Type A packagings, the pertinent regulations in Title 10 of the Code of Federal Regulations, Part 71 (10 CFR Part 71), must be satisfied. These packagings are designed to retain their contents under normal transportation conditions.

Shipments of high-level radioactive materials require the use of highly robust Type B packaging, which is designed and tested to prevent the release of contents under both normal conditions of transport and hypothetical accident conditions prescribed in 10 CFR Part 71.

The following pages feature the Type B and Type AF transportation packagings certified by DOE/PCP/EM-63.

Dr. James Shuler
Manager, Packaging Certification Program
August 8, 2008

EM Environmental Management
safety ❖ performance ❖ cleanup ❖ closure
DOE Packaging Certification Program

BUSS

USA/9511/B(U)-85 (DOE), Rev. 7

Expiration Date: March 31, 2008

Beneficial Uses Shipping System (BUSS) Cask, Safety Analysis Report for Packaging, Volumes I and II, HNF-SD-TP-SARP-024, Rev 0, March 1997.

Description:

The major components of the packaging include the cask body and lid, basket, impact limiters, personnel barrier, and skid. The cask body is a cylindrical forging with outer dimensions of 137.8 cm diameter and 124.5 cm high. The cavity is 51.4 cm in diameter and 58.4 cm high. On the outside surface of the cask body, eleven, 10.2-cm high integral, non-welded fins are situated symmetrically around the circumference of the cask for heat removal. The cask lid is a single 32.6-cm thick forging and is bolted to the cask body using 12 corrosion-resistant steel 1.5-inch diameter bolts through a 9.7-cm thick lid flange. The lid seal is provided by a combination elastomeric-metallic seal. The metallic seal is responsible for providing the necessary leak tightness while the elastomeric seal, which is located outboard to the metallic seal, provides an annular test volume that enables leak testing of the metallic seal. Two covered ports on the side of the cask body, equipped with testable seals, are provided for filling the cask cavity with helium before transport, filling the cavity with water before unloading contents, and draining entrapped water after unloading or loading contents. A permanent repair plug was threaded and seal-welded into the cask body at the upper port to correct a fabrication machining error that damaged the sealing surface. This plug forms a new surface for the upper drain plug seal. A removable bore plug was also added to the upper port to reduce the unexpected radiation streaming.

Contents:

Capsules of melt-cast cesium chloride or press-filled strontium fluoride that have been qualified by testing or examination to satisfy the requirements of Special Form as set forth in 10 CFR 71.75 within the 12 months preceding shipment. Examinations and tests different from those authorized in 10 CFR 71.75 must be approved in advance by the DOE Headquarters Certifying Official.

See USA/9511/B(U)-85 (DOE), Rev. 7 for additional details and conditions of approval.

MAXIMUS LEU

USA/9865/AF-96 (DOE)
Rev. 1

Expiration Date:
July 31, 2008

Safety Basis for Certification of Project Maximus LEU Type A Drums as a Type AF Packaging Configuration,ORNL/NTRC-020/ Vol. l and 2, Rev.1, Feb. 2007.

Description:

The packaging is a DOT 7A Type A drum containing a square wooden box (overpack) that surrounds an inner metal canister, which contains low-enriched uranium (LEU) oxide. The packaging consists of a 16-gauge, 55-gallon galvanized carbon steel drum with three rolling hoops, manufactured to the ORNL Specification No. 100-1A2-007 and meeting DOT 7A Type A requirements. The drum has a 16-gauge removable lid, 12-gauge closure ring with 518-inch diameter bolt and nut, and elastomer gasket. The inner metal canister is approximately 12-in diameter, 20-in height, 0.06-in wall, and is likely made of either carbon steel or stainless steel. The wooden box has approximate dimensions of 15-inch by 15-inch square and 25-inch tall. The wooden box consists of layers of wood boards that are nailed and tied together with four long bolts and two angle steel on top of the wooden box for lifting and handling.

Contents:

Uranium dioxide (UO_2) powder with a U-235 enrichment of nominally 2.593 wt.%; ranging between 2.321 and 2.872 wt.%.

The reported net weight of LEU oxide per package is 27.3 ± 0.1 kg. Based on the reported uranium weight fraction and ^{235}U enrichment, each package contains nominally 23.759 kg of U with 616 g of ^{235}U. Accounting for mass and isotopic measurement uncertainties, a maximum of 23.933 kg of U containing up to 691 g of ^{235}U per package is permitted.

Maximum gross weight of each drum shall be less than 227.3 kg.

See USA/9865/AF-96 (DOE), Rev.1 for additional details and conditions of approval.

ORNL TRU C_f

USA/5740/B( ) (DOE)
Rev. 0

Expiration Date:
Oct. 1, 2008

Safety Analysis Report for Packaging (SARP) of the Oak Ridge National Laboratory TRU Californium Shipping Container, Report ORNL-54091R4, April 1992

Description:

A 304L stainless steel encased concrete shipping cask. The outer shell consists of two, 1.3-cm thick, 167.6-cm diameter hemispherical heads joined by a 15.2-cm cylindrical section. The cylindrical cavity has a 2.5-cm thick stainless steel wall and is 7.6-cm in diameter X 15.2-cm long. Shielding consists of 76.2-cm of Blackbrn Limonite concrete having a density of approximately 2.8 g/cm^3. Upper and lower level ball valves located at the end of concrete-fined plugs define, isolate, and seal the cavity. Both of these plugs have O-ring seals, are bolted in place, and are protected with a gasketed cover plate. Fusible plugs are located in the cover plate and the shell.

The top ball valve and plug may be replaced by other plugs for multiple source shipments. *Sources are contained in special* form *inner containers.*

The cask is mounted onto a 2.5-cm thick steel base plate by eight steel 6.4-cm NPS Schedule 40 pipe struts. The cask is transported on a special trailer. The gross weight of the cask is 10,682-kg.

Contents:

(1) Type and Form of Material:

The contents consist of isotopes of Americium (Am), Curium (Cm), Berkelium (Bk),.Califomium (Cf), Einsteinium (Es), and Fermium (Fm) as a solid (metal, oxide, oxysulfate, or dry salt), contained in capsule(s) that meet the requirements of special form radioactive material.

(2) Maximum Quantity of Material Per Package:

For the contents described in 5(b)(1):

Three (3) grams and the maximum internal heat no to exceed five watts.

See USA/5740/B( )-85 (DOE), Rev. 10 for additional details and conditions of approval.

4.5-Ton C_f

USA/6642/B( ) (DOE)
Rev. 0

Expiration Date:
Oct. 1, 2008

Safety Analysis Report - Packaging SRL 4.5 Ton Californium Shipping Cask, DPSPU 74-124-6, Rev. 1, as supplemented September 19, 1991

Description:

A shielded packaging for special form materials. The outer container is a 1.9 cm, 156.2 cm OD spherical steel filled with borated water extended polyester (WEP) shielding. Outer shell is fitted with nine (9) fusible plugs and a vent valve for relief of gases generated in the WEP material. The cylindrical containment cavity approximately 10.2 cm diameter by 16.2 cm high is centrally located in the sphere and surrounded by lead 5.1 cm, 4.8 cm, and 4.4 cm thickness on the bottom, sides and top, respectively. The containment vessel is an integral part of the outer container, and is held by 80 cm long 11.4 cm OD tube welded to a 1.9 cm thick, 57.2 cm diameter top plate mounted to the outer container closure assembly. Closure of the containment vessel is accomplished by a flange plate and sleeve insert assembly. The sleeve is 68.6 cm long, 10.2 cm OD tube filled with lead and water extended polyester and is gasketed and bolted to the top closure assembly of the container. A 57.2cm diameter protective cover bolts to the closure assembly sleeve. A hexagonal shaped assembly, approximately 152.4 cm across the flats mounts, to the spherical shell as a base. Four equally spaced lifting lugs are provided around the upper hemisphere. The cask gross weight is approximately 4,309.1 kg.

Contents:

(1) Type and Form of Material:
Californium 252, as sealed source which meets the requirements of special form radioactive material

(2) Maximum Quantity of Material Per Package:
46 curies (85mg).

See USA/6642/B( )-85 (DOE), Rev. 0 for additional details and conditions of approval.

BCL-3

USA/9067/B( )F (DOE)
Rev. 0

Expiration Date:
Oct. 1, 2008

Safety Analysis Report - Packages (SARP), Model BCL-3 Shipping Cask, Rev. B, Battelle's Pacific Northwest Laboratory, March 1992

Description:

Steel encased, lead shielded shipping package. The packaging is provided with a recessed, plug-type lid and gasketed, bolted closure; lifting and tie-down devices; and a drain line penetration. Containment for the contents is provided by an inner can assembly or by material in special form. The packaging dimensions, weight, and shielding are as follows:

Exterior height - 67.1 cm; Exterior diameter - 48.3 cm
Cavity height - 26.7 cm; Cavity diameter - 1 1.4 cm
Lead shielding - 15.2 cm; Loaded weight - 1,270 kg (including 49.9 kg skid)

Contents:

(1) Material Type and Form

Byproduct material, source material, and special nuclear material in solid metal or oxide form, which is packaged within the inner can assembly specified in item 5(a)(3), or which meets the requirements of special form radioactive material.

(2) Maximum Quantity

Not to exceed 300 watts decay heat and
,
(i) Fissile material not to exceed 100 grams U-235 equivalent mass.
(ii) Fissile material not to exceed 2,000 grams U-235 equivalent mass.

See USA/9067/B( )-85 (DOE), Rev. 0 for additional details and conditions of approval.

CNS 1-13C

USA/9081/B( ) (DOE), Rev. 0

Expiration Date: Oct. 1, 2008

Safety Analysis Report for Model CNS 1-1 3C Type B Shipping Packaging, Revision 2, July 1999, as supplemented (see 5(d))

Description:

A steel encased lead shielded shipping cask. The packaging is a steel double-walled, leadfilled circular cylinder. A steel plug-type, lead-filled lid is attached with twelve, 1-1/4" bolts; and a silicone gasket. Outer steel sheets are separated from the cask walls with small diameter wires. The lead shielding is 5" in the sides, 6" in the base and 5-3/4" in the lid. Two bolted-on steel lugs are for lifting only. The lid has a steel U-bar for lifting. The cavity drain line is closed with a plug. The cask is 39" in diameter and 68-1/2" long. The cavity is 26-1/2" in diameter and 54' long. The package weight is about 26,000 pounds.

Contents:

Type, form, and maximum quantity of material per package.

(1) Greater than Type A quantity of byproduct material as solid metal. Decay heat not to exceed 600 watts; or

(2) Decay heat not to exceed 5 watts, and:

(i) Process solids, either dewatered, solid, or solidified, in a secondary sealed container, meeting the requirements for low specific activity material; or
(ii) Solid reactor components in secondary containers, as required, that meet the requirements for low specific activity material.

(3) Maximum gross weight of the contents, secondary container, and shoring is limited to 5,000 pounds.

See USA/9081/B( )-85 (DOE), Rev. 0 for additional details and conditions of approval.

CNS 1-13G

USA/9216/B( ) (DOE), Rev. 0

Expiration Date: Oct. 1, 2008

Safety Analysis Report for Model CNS 1-13G Shipping Container, Revision 0, December 1987, as supplemented [see 5{e))

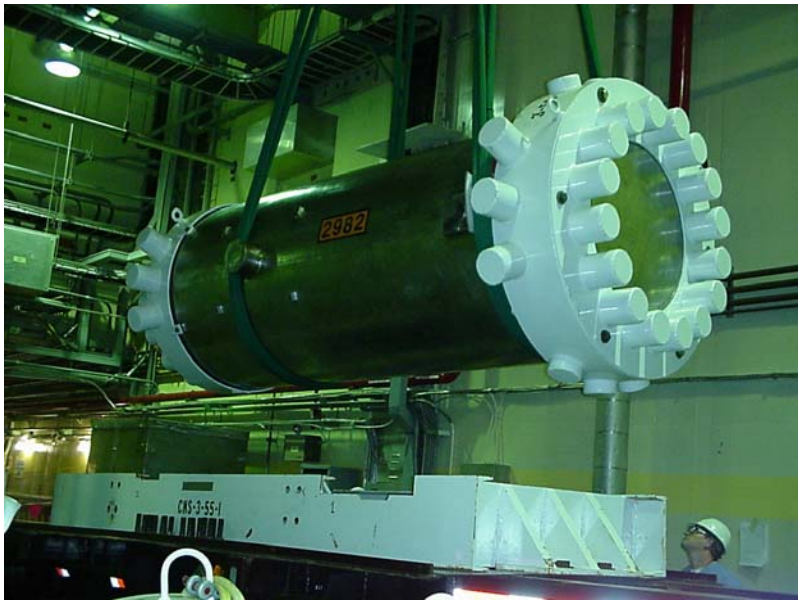
Description:

A steel encased lead shielded shipping cask. A double-walled steel cylinder protective jacket encloses the cask during transport. It is bolted to a steel pallet. The cask is closed by a lead-filed flanged plug fitted with a silicone rubber gasket and bolted closure. The cavity is equipped with a drain line and the physical dimensions and weight are: Cask Height: 170.66 cm; Cask diameter: 97.8 cm; Cast height: 137.2 cm; Cavity diameter: 67.3 cm; Lead shielding: 12.7 cm; Protective jacket height: 207.8 cm; Protective jacket width: 172.7 cm; and Packaging weight: 11,567 kg.

Contents:

Plutonium in excess of 20 curies per package must be in the form of metal, metal alloy or reactor fuel elements; and (1) Byproduct material and special nuclear material as solid metal or oxides. Decay heat not to exceed 600 watts. The radioactive material shall be in the form of fuel rods, or plates, fuel assemblies, or meeting the requirements of special form radioactive material: 500 gm U-235 equivalent mass; or (2) Neutron sources meeting the requirements of special form radioactive material: 500 gm U-235 equivalent mass. Decay heat not to exceed 50 watts; or (3) Irradiated PuO_2 and UO_2 fuel rods clad in Zircalloy or stainless steel. Decay heat not to exceed 600 watts. All fuel rods shall be contained within a closed 12.7 cm Schedule 40 pipe with a minimum useable length of 100.65 cm: 1200 gm fissile material with no more than 300 gm fissile material per 12.7 cm Schedule 40 pipe. (4) Process solids, either dewatered, solid, or solidified, in a secondaly sealed container, meeting the requirements for low specific activity radioactive material. Fissile materials must meet the exemption standards in 10 CFR 71.15. (5) Solid nonfissile irradiated metal hardware, reactor control rods (blades), reactor start-up sources, and segmented boron carbine tubes (tube contents not to exceed a Type A quantity). (6) Radioactive (Hot Cell) waste materials immobilized with cement grout and contained in a55-gallon (or extended 55-gallon drum) DOT Specification 17H or 17C steel drum, lid and closure. The waste material must be packaged in accordance with the Procedural Outline of the Immobilization of Cell Waste Using Cement Grout. Decay heat not to exceed 100 watts, and fissile material not to exceed 500 g of U-235 equivalent mass. .

See USA/9216/B( )-85 (DOE), Rev. 0 for additional details and conditions of approval.



CNS 3-55

USA/5805/B( ) (DOE)
Rev. 0

Expiration Date:
Oct. 1, 2008

Safety Analysis Report for Model CNS 3-55 Type B Shipping Packaging, Revision 5, February 2007, as supplemented [see 5(d)]

Description:

The packaging is a steel-encased, lead-shield cask with crushable impact limiters. The basic cask is a steel cylinder 339.7-cm long by 128.3-cm in diameter with a maximum cavity dimensions of 91.4-cm In diameter by 294.6-cm long reduced to 281.9-cm by the shield ring attached to the lid cover. Shielding is provided by 15.24-cm of chemical lead in the sides and closure base plate and 13.34-cm in the closed end.

The outside steel encasement is made up of two, 1.27-cm plates on the sides and three plates totaling 6.67-cm on the end. The containment vessel is a 0.64-cm thick cylinder with a 1.27-cm end plate. The shells are welded together with the lead shielding poured to fill the annular and end spaces. The removable, flanged and recessed base plate weldment consists of 0.95-cm and 3.18-cm outside plates and a 1.59-cm (5/8-in) inside plate. The space between the plates is lead-lined. The base plate is secured to the cask body by means of twelve, 3.8-cm high strength bolts and nuts and sealed with two silicone O-rings. The cavity is penetrated by a vent line at the closed end and a drain line through the base plate. The vent line is sealed by a gasketed and shielded plug. The drain line is sealed with a 25 psig relief valve.

Contents:

(1) Type and form of material

Depleted Antimony-Beryllium (Sb-Be) neutron sources and irradiated metal components packaged in secondary containers.

(2) Maximum quantity of material per package

Package internal decay heat load not exceed 250 watts. The source strength of depleted neutron sources not to exceed 2.3 curies of Antimony-124.

See USA/5805/B( )-85 (DOE), Rev. 0 for additional details and conditions of approval.

CI-20WC-2 and CI-20WC-2A

USA/9098/B( ) (DOE) Rev. 2

Expiration Date: Oct. 1, 2008

Cintichem, Inc. Safety Analysis Report for the CI-20WC-2/2A Packagings, as supplemented, Aug. 20, 1987

Description:

Steel encased, wooden outer protective jackets with a uranium shielded cask and inner steel containment vessel. The protective jackets are constructed of disks and rings of plywood, which are glued together and reinforced with steel rods. The protective jackets are contained within an 18-gauge steel drum. The shielded casks have depleted uranium shields encapsulated in steel with a gasketed and bolted flange closure with six, 3/8"-16 UNC-2A x 3/4" long bolts. The inner containment vessel is a 2.73" OD x 5.56" long 416 stainless steel, gasketed and threaded container. The gross weight of the packages is about 400 lbs.

Contents:

(1) Type and Form of Material:

(i) Mo-99/Tc-99 in normal form as solids or liquids.

(ii) 1-131 in normal form as liquids.

(2) Maximum Quantity of Material per Package:

(i) For the contents described in 5(b)(1)(i): 1000 curies

(ii) For the contents described in 5(b)(1)(ii): 200 curies

See USA/9098/B( ) (DOE), Rev. 2 for additional details and conditions of approval.

6400

USA/6400/B( )F (DOE)
Rev. 5

Expiration Date:
Oct. 31, 2008

Safety Analysis Report for Packaging Super Tiger Shipping Container as adapted for LWBR Type Fuel Rods, WAPD-LP(FE)-220, Revision 4, September 1985. as supplemented (see 5(e)).

Description:

The protective overpack provides physical containment, impact resistance and thermal protection for its contents. The inner shell (cavity) is approximately 193 cm x 193 cm x 437 cm constructed of 0.48-cm thick and 10 gauge mild steel. Closure of the cavity is by a 0.64-cm thick aluminum plate with silicone rubber gasket bolted to the main inner shell. The cavity is centered and supported in an outer 0.48-cm thick steel jacket by approximately 81 cm of polyurethane foam insulation at the end and 25 cm on the sides. A side hinged rear access door consisting of approximately 86 cm of polyurethane foam insulation encased in steel with a silicone rubber gasket is bolted to the main outer steel jacket. The overall dimensions of the package are ≈ 244 cm x 244 cm x 610 cm. Set into each corner of the outer container are standard steel tie down fittings. The maximum weight including the weight of the contents is 20,412 kg.

Contents:

Uranium 233 oxide and thorium oxide in the form of intact unirradiated LWBR-type fuel rods and unirradiated LWBR fuel pellets, various short fuel rods, and other miscellaneous LBWR related material in stalnless steel tubes with the following limitations:

(i) Fuel rods and fuel tubes must be packaged within the Model No. 6400 packaging as described in Section 1 of WAPD-LP(FE)-220, Rev. 4 (September 1985);
(ii) The fuel content must not exceed 50 kg U-233 per shipment;
(iii) All rod storage containers must be filled to capacity (at least 70% of cross-sectional area) with rods or aluminum shim stock;
(iv) Each rod storage container must contain not more than one sub-container of 5/9 or 12 w/o BMU seed rods;
(v) Each rod storage container must weigh not more than 907 kg (2,000 pounds);
(vi) The fuel rod and fuel tube heat generation must not exceed 30 watts; and
(vii) Operating Procedures and Acceptance Tests and Maintenance Program must be modified to meet the requirements of condition 8 of this approval.

See USA/6400/B( )F (DOE), Rev. 5 for additional details and conditions of approval.

T-3

USA/9132/B(M)F (DOE), Rev. 13

Expiration Date: Dec. 31, 2008

Richland Operations Office Consolidated Safety Analysis Report for the T-3 Spent Fuel Shipping Cask, Revision 6a; Addendum to T-3 SARP [see 5(e)], October 2006.

Description:

T-3 is a stainless steel and lead shielded irradiated fuel shipping package (cask). The cask is a right circular cylinder with upper and lower steel-encased rigid polyurethane foam (0.32 g/cm^3) impact limiters. The overall dimensions are 541.5 cm in length and 132.1 cm in diameter. The cask without the impact limiters measures 450.1 cm in length and 67.16 cm in diameter. The outer cask shell is comprised of a 2.54-cm-thick stainless steel shell overlayed with a 10-gauge stainless steel cover. Between these two materials is a 0.2-cm diameter wire wrap providing an air gap for additional thermal protection. The inner shell (containment vessel) is a standard seamless stainless steel Schedule 40 pipe having an outside diameter of 21.9 cm with a nominal wall thickness of 0.82 cm. The annular space between the inner and outer shells is filled with lead having a thickness of 20.3 cm.

Both the inner and outer shells are welded at each end to heavy steel closure plates with conical surfaces to assist in positioning and sealing. The containment vessel measures 373.4 cm in length by 20.27 cm in diameter. The containment vessel is sealed at the bottom end with a 30.05-cm thick stainless steel plug with two Viton O-ring seals. ….. No drain or vents penetrate directly into the containment vessel. A drain/vent line opens directly into the area between the two O-ring seals at each end of the cask (end plugs). During shipment, the lines are sealed with Viton O-ring sealed threaded fasteners. …. The cask is tied down at the forward and aft ends by means of a cradle and yoke assembly. The gross weight of the cask and contents is 17,364 kg.

Contents:

Type 1 in this revision is equivalent to Type 7 in Revision 12. The plutonium in Type 1 contains at least 10% Pu-240.Type 2 in this revision is equivalent to Type 12 in Revision 12.Type 3 and Type 4 in this revision are variations on Type 13 from Revision 12. For Type 3 and Type 4, the pins or fuel pin assembly (cropped) are placed inside the 6CVL Independent Fuel Canister Containment Vessel Assembly described in Section 1.2.2.1 of the Addendum [See *5(e)].* Type 5 in this revision is equivalent to Type 2 in Revision 12. The plutonium in Type 5 contains at least 10% Pu-240. Type 6 in this revision is equivalent to Type **11** in Revision 12.

See USA/9132/B(M)F (DOE), Rev. 13 for additional details and conditions for approval.

SAFESHIELD 2999A

USA/9519/B(U)-96 (DOE), Rev. 0

Expiration Date: Oct. 31, 2010

Safety Analysis Report for Packaging SAFESHIELD 2999A Package Docket 99-7-9519 SARP 2999A, Rev. 4, July 4, 2005.

Description:

The packaging consists of a shielding flask (Flask 2993) carried in an outer double skinned insulated casket (Casket 2999). The outer dimensions of the packaging are 1396 mm high by 1040 mm in diameter. The nominal weight of the packaging is 3853 kg, excluding contents. The maximum contents weight is 100 kg.

The Casket 2999 consists of a double skinned low carbon steel base assembly and a double skinned low carbon steel cover assembly. The cover assembly is fastened to the base assembly with stainless steel studs and nuts. The cavities between the double skin of the base assembly and cover assembly are filled with a Thermal Insulating and Shock Absorbing Foam (TISAF), a phenolic resin foam. The cavities in the casket base assembly and cover assembly are normally sealed but will vent through the vent plugs in the outer shell during a hypothetical accident fire. The Casket 2999 is fitted with internal shock absorbing aluminum honeycomb on top of the base assembly and at the inside top of the cover assembly. The Flask 2993 stands on the aluminum honeycomb fitted on top of the base assembly. The Flask 2993 is fabricated as a stainless steel shell to which is fitted a stainless steel containment vessel, with the space between the containment vessel and Flask 2993 body shell filled with 4% Sb lead shielding. The Flask 2993 has an overall height of 912 mm and an overall diameter of 669 mm, and the cavity dimensions are 400 mm high by 220 mm in diameter. The radial thickness of the 4% Sb lead shielding on the flask side is nominally 213 mm. The shielding in the base and top plug is slightly greater than the radial thickness.

Contents:

(i) Special form sources as specified in Table 1.
(ii) Non-special form encapsulated materials as specified in Table 2.
(iii) Irradiated accelerator targets [except Low Melting Point (LMP) metal accelerator targets] as specified in Table 3.
(iv) Ion exchange canister as specified in Table 4.
(v) Radioactive waste material from handling irradiated targets as specified in Table 5.
(vi) Irradiated LMP metal accelerator targets as specified in Table 6.

See USA/9519/B(U)-96 (DOE), Rev. 0 for details in Tables 1 to 6 and conditions of approval.

Mound 1 kW

USA/9516/B(U)F-85 (DOE), Rev. 14

Expiration Date: Feb. 28, 2011

MLM-MU-91-64-001. Rev 7c Safety Analysis Report for Packaging (SARP) for the Mound 1KW Package, as supplemented See 5(e)(1), Feb. 2006.

Description:

The Mound 1 kW Packaging consists of a pallet with the cylindrical cask bolted upright in its center. The pallet is of stainless steel and is welded to 20.3 cm by 10.2 cm carbon steel rectangular tubes. The rectangular tubes provide for handling by forklifts. The cask is surrounded by a mesh barrier supported by steel bars that keeps personnel about 25 cm from the cask except at the bottom where the mesh keeps personnel about 14 cm away. The mesh barrier is 781 cm square by 864 cm tall. The mesh barrier is welded to the pallet and, along with the pallet, defines the accessible surface of the package.

Tie-down brackets are provided on the steel bars that support the mesh personnel barrier. The tie-down brackets are designed so they cannot be used for overhead lifting. Access to the cask is through the top panel and one side panel of the mesh barrier; these removable panels
are held in place by screws.

The cask is of 304L stainless steel 241 cm outside diameter by 49.5 cm tall outside and 3.81-cm thick. The cask IS closed by a bolted flange lid which is designed to confine the large components Inside the cask but not to provide containment for radioactive particles.

Contents:

The Mound 1KW package IS desiqned for shipping heat source plutonium (primarily ^{238}Pu) in various chemical forms and mechanical configurations. This Certificate approves Its use for shipping 0.5 kW or less in the following configurations:

(i) Powdered plutonium oxide.

(ii) Various configurations containing General Purpose Heat Source (GPHS) Fueled Clad Assemblies (FCAs) that have been pressed from powdered plutonium oxide

(iii) An additional configuration Includes three fueled capsule assemblies, limited to 166.7 W each, located in a graphite support block, sealed Inside a Primary Containment Vessel (PCV). A graphite filler block rests on top of the PCV and sealed inside the Secondary Containment Vessel (SCV).

See USA/9516/B(U)F-85 (DOE), Rev. 14 for additional details and conditions of approval.

RTG

USA/9904/B(U)F-85 (DOE), Rev. 11

Expiration Date: Feb. 28, 2011

Radioisotope Thermoelectric Generator Transportation System, Safety Analysis Report for Packaging, WHC-SD-RTG-SARP-001, Revision O-E; Addenda - see 5(e) References.

Description:

The RTG Package is approved for shipping the General Purpose Heat Source (GPHS) Radioisotope Thermoelectric Generator (RTG), the HPG (High Performance Generator) MOD-3 RTG, the HPG MOD-3 isotopic heat source (IHS), 10 GPHS fueled clads or one or two Radioisotope Stirling Generator 10 Watt (RSG 10W). The HPG MOD-3 IHS is contained in a stainless steel, bolted closure storage protection container (SPC). The 10 GPHS fueled clads are contained in four stainless steel containers: a bolted closure delta seal container, a welded product can, and two welded EP-61 containers, The RSG 10W Mount Assembly is fabricated from various aluminum shapes and contains an adaptor base plate that interfaces with the HPG MOD-3 RTG shipping rack. The GPHS and the HPG MOD-3 RTGs contain up to 4,500 watts thermal and up to 2,500 watts (thermal) power, respectively, generated from all sources (primarily from the ^{238}Pu isotope). A RSG 10W contains up to 62.5 watts (125 watts for two RSG 10W paylaods), generated from all sources (primarily from the ^{238}Pu isotope). The HPG MOD-3 IHS contains up to 2,500 watts and the 10 GPHS fueled clads contain up to 625 watts (thermal) power. The ^{238}Pu in all payloads is in the chemical form of PuO, and in the physical form of pressed, sintered pellets (cylindrical or spherical) sheathed in iridium with a filtered vent to release the helium generated by radioactive decay.

Contents:

The RTG Package contents are limited to one GPHS RTG, one HPG MOD-3 RTG, one HPG MOD-3 IHS, 10 GPHS fueled clads, or one or two RSG 10W payloads per package. The exclusive use trailer used to transport the package may contain one package containing a GPHS RTG or two packages each containing an HPG MOD-3 RTG, an HPG MOD-3 IHS, 10 GPHS fueled clads or one or two RSG 10W. The weight of the RTG and its shipping rack shall not exceed 340.2 kg, the weight of the HPG MOD-3 IHS payload and its container, adapter, and shipping rack shall not exceed 249.4 kg, and the weight of the 10 GPHS fueled clads payload and its containers, adapter, and shipping rack shall not exceed 149.7 kg.

See USA/9904/B(U)-85 (DOE), Rev. 11 for additional details and conditions of approval.

9975

USA/9975lB(M)F-85 (DOE), Rev. 18

Expiration Date: March 31, 2011

Safety Analysis Report for Packaging Model 9975, B(M)F-85 WSRC-SA-2002-00008, Revision 0, December 2003 Addendum 1. S-SARA-G-00001 Revision 0. April 2005.

Description:

The components of the package include the drum, insulation, bearing plates, primary containment vessel (PCV), secondary containment vessel (SCV), lead shielding, and aluminum honeycomb spacers. An aluminum PCV sleeve or 3013 top and bottom spacer may be used, depending on the type of product can to be transported. The nominal net weight of the packaging ranges from 159-1 68 kg. The drum is fabricated as a 132-liter (35-gallon) bolted lid drum of 18-gauge Type 304L stainless steel. Four 1.3-cm diameter vent holes are drilled into the drum, approximately 90 degrees apart, 2.5 cm below the drum flange and are covered with plastic Caplugs (fusible plugs). The plugging devices prevent water from entering the drum through the vent holes under normal conditions of transport. In the event a fire occurs, the plugs melt, allowing the drum to vent gases generated from the insulation to prevent rupture of the drum. The drum lid is bolted to a 3.2-cm wide by 0.3-cm thick angle flange welded to the top of the drum body using 24 1.3-cm high-strength bolts. The lid is recessed 1.4 cm. A 0.3-cm thick by 3.2-cm wide circular ring is welded to the outer section of the lid. The ring serves to reinforce the lid and prevents the lid from shearing away from the bolts during a hypothetical accident condition event. Nuts are tack welded to the flange underside to ease assembly operations. The bolts are tightened to 40.7 ± 2.7 N-m (30 ± 2 ft-lbs) of torque.

See USA/9975/B(M)F-85 (DOE) for additional details.

Contents:

(i) Uranium metal or oxide as specified in Content Envelope C.1 in Table 1.
(ii) Plutonium-238 heat sources as specified in Content Envelope C.2 in Table 1.
(iii) Plutonium and/or uranium metal as specified in Content Envelope C.3 in Table 1.
(iv) Plutonium and/or uranium oxide as specified in Content Envelope C.4 in Table 1.
(v) Plutonium composites as specified in Content Envelope C.5 in Table 1.
(vi) Plutonium/tantalum composites as specified in Content Envelope C.6 in Table 1.
(vii) Plutonium-238 oxide/beryllium metal as specified in Content Envelope C.7 in Table 1.
(viii) Neptunium oxide as specified in Content Envelope C.8 in Table 1.

See USA/9975/B(M)F-85 (DOE), Rev. 18 for details in Table 1 and conditions of approval.

5320

USA/5320/B(M)F-85 (DOE), Rev. 0

Expiration Date: April 30, 2011

Safety Analysis Report - Packages (SARP), 5320 Shipping Package, R1033-004-ES-00, Rev 0, March 2006.

Description:

The 5320 Shipping Package is a dome-topped, upright circular cylinder mounted on a base plate supported by casters as shown in Figures 1 and 2. In both of these figures, the names of major components are given in capital letters. The maximum weight of the packaging plus payload is 148.3 kg (327 lb), and nominal height excluding the casters and mounting plates is ≈ 82.9 cm (32.65 in.). Including the casters and mounting plate, the overall height of the 5320 Shipping Package is approximately 95.3 cm (37.5 in.). Again excluding the base plate, the largest diameter is 19.3 cm (16.75 in.). The base plate is 45.7 cm (18 in.) by 50.8 cm (20 in.). The packaging payload volume has a nominal length of 37.0 cm (14.58 in.), and a nominal diameter of 4.4 cm (1.74 in.).

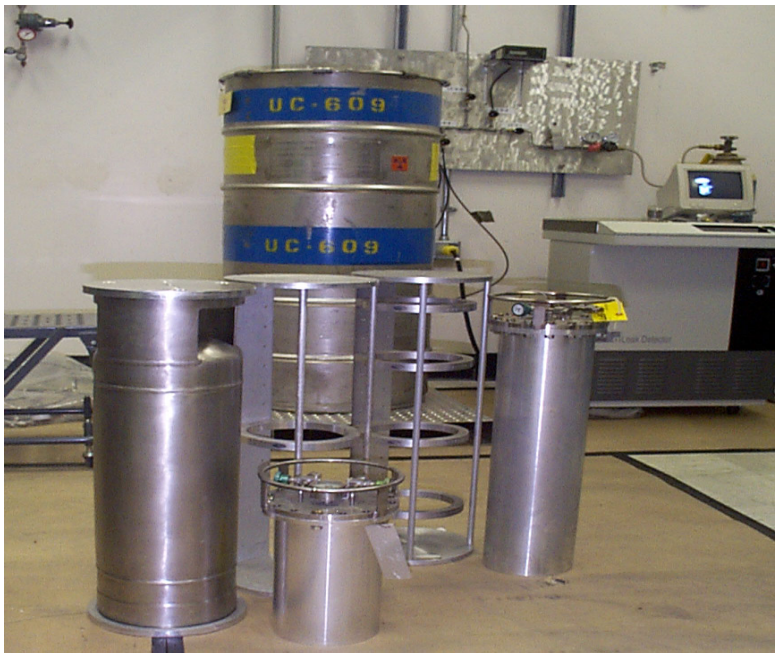
The contents of the package (normally handled in the EP-60 product canister) are seal welded into the removable stainless steel primary containment vessel (PCV). The stainless steel secondary containment vessel (SCV) has a removable bolted closure lid. The flange of the SCV has concentric Buna-N™ O-ring and Flexitallic™ gasket seals that satisfy the containment requirements for normal conditions of transport (NCT) and hypothetical accident conditions (HAC), respectively.

Contents:

(1) Material Type and Form
Plutonium as oxide (PuO_2), in any solid form, such as granules, scrap, pellets, or powder, up to a maximum of 11.2 g/cm^3 bulk density. The PuO_2 may contain up to 100% ^{238}Pu, ^{239}Pu, or ^{242}Pu as indicated in Table 1.2 of the SARP.

(2) Maximum Quantity
357 g of plutonium (oxide mass is greater) with allowed isotopic ratios listed in Table 2 (the table presents a time-zero "snapshot" at the beginning of an 18-year time frame over which decay products were evaluated). Plutonium at these quantities may exceed 20 Ci.

See USA/9150/B(U)-85 (DOE), Rev. 0 for details in Table 2 and conditions of approval.



UC-609

USA/9932/B(U) (DOE)
Rev. 11

Expiration Date:
Aug. 31, 2011

Safety Analysis Report for Model UC-609 B(U) DOE Shipping Package, UCRL-ID-111494, Rev. 3, March 2006.

Description:

The UC-609 package consists of a containment vessel centered by Celotex insulation inside a 100-gallon drum. The tritium contents are carried in a storage vessel inside the containment vessel. The package gross weight is 226.8 kg. The drum has a maximum diameter of 63.5 cm and a total height of 138.4 cm. The drum is the open head type with a flat cover secured by eight J-shaped brackets rather than the locking ring typically used with open head drums. Rotation of the drum cover is prevented by means of a 10-32 UNF stainless steel set screw installed through a tapped hole on the underside of each bracket The drum is fabricated of 14 gauge (0.19 cm) 304 stainless steel to Military Standard MS 27683. To vent the drum, no gasket is used between the cover and drum body and, in addition, there are four 0.54-cm holes evenly spaced around the drum body 5.1 cm below the cover. The vent holes are sealed weather tight by pressure-sensitive adhesive tape.

The drum is lined with ASTM C 208 roof-grade Celotex insulation board. The minimum thickness of the lining is 7.2 cm. The insulation disks at the top of the drum are supported by a plywood disk that forms the top containment vessel cavity and rests on the annular disks lining the drum sides. Protecting the Celotex disks next to the drum cover is a bottle-cap shaped heat shield of 304 stainless steel. The heat shield is cemented to the outer surface of the Celotex. Between the drum cover and the metal heat shield is a 1.3-cm thick disk of Alumina-silica ceramic fiber (Cerafelt) produced by Thermal Ceramics Company.

Contents:

(1) Type and Form of Radioactive Material
Tritium in the form of gas, tritiated water, or metal tritides, contained in a storage vessel.

(2) Maximum Quantity of Radioactive Material per Package
Not more than 100 grams of tritium with the decay heat not to exceed 32 watts.

See USA/9932/B(U) (DOE), Rev. 11 for additional details and conditions of approval.

PAT-2

USA/9150/B(U)-85 (DOE), Rev. 0

Expiration Date: Oct. 31, 2012

PAT-2 (Plutonium Air-Transportable Model 2) Safety Analysis Report, SAND81-0001, Printed 1981, as supplemented. Note: Shipments by Air are not authorized.

Description:

A superalloy primary containment vessel (TB-2) surrounded by a protective overpack (AQ-2). The contents which may be in canisters are contained within a capsule (C-I) within the TB 2.

The AQ-2 overpack is a right circular cylinder, approximately 356 mm (14 inches) high and 381 mm (15 inches) in diameter with protruding handles attached to the cylinder outer walls. The outer shell is a double walled stainless steel structure with rounded end caps, riveted on the bottom and bolted at the top. An inner grain oriented maple wood protective case house the TB-2; it is surrounded by a titanium load spreader which is further surrounded by a grain oriented redwood protective case.

The TB-2 containment vessel consists of (2) iron-base superalloy sections, bolted together with (20) bolts, forming an 88 mm diameter sphere. A copper gasket held between knife-edge sealing beads on the matting hemispherical surfaces of the TB-2 provides a seal. The C-1 capsule is a stainless steel cylinder with a nominal 44 mm diameter and nominal 70 mm length; it has a screw top lid which is sealed with Teflon tape.

Brass or aluminum canisters may be used in the C-1 capsule to hold various radioactive contents. The canisters may have quartz or glass liners. The package gross weight is approximately 33kg.

Contents:

(1) Plutonium, uranium, or mixture of plutonium- uranium in various isotopic compositions in solid form as: (i) oxide powder, sintered oxide pellets, and metal; (ii) plutonium sulfate tetra-hydrate, $Pu(SO_4)_2 4H_2O$ and plutonium nitrate dehydrate, $Pu(NO_3)_4 2H_2O$.

(2) Maximum Quantity of Radioactive Material per Package
(i) for the contents described in 5(b)(1)(i): Not to exceed 15 grams fissile material, 120 grams mass, 2 watts decay heat, or 0.5 gram water. (ii) for the contents described in 5(b)(1)(ii): Not to exceed 3 grams or 0.5 grams water in addition to the water of hydration.

See USA/9150/B(U)-85 (DOE), Rev. 0 for additional details and conditions of approval.

NAC-LWT

USA/9225/B(U)F-96 (DOE), Rev. 5

Expiration Date: Oct. 31, 2012

Safety Analysis Report for Packaging for the NAC Legal Weight Truck Cask, Revision LWT(D0E)-O6D September 2006 as Supplemented by LWT/ DOE-07E, September 2007

Description:

The NAC-LWT is a steel-encased, lead-shielded shipping cask. The cask is approved for transport of Sandia National Laboratories (SNL) Debris Bed Experiments (DBE) contained in welded stainless steel DBE Transport Canisters. The DBE Transport Canister provides a secondary leaktight boundary for the DBE contents. When presented for transport, the cask contents will be up to three individual DBE Transport Canisters and appropriate spacers as required.

The overall dimensions of the package, with impact limiters, are 589 cm long by 166 cm in diameter. The cask body is ≈508 cm in length and 112 cm in diameter. The cask cavity is 452 cm long and 34.0 cm in diameter. The volume of the cavity is ≈411 liters. The cask body consists of a 1.91-cm thick stainless steel inner shell, a 14.61-cm thick lead gamma shield, a 3.1-cm thick stainless steel outer shell, and a neutron shield tank. The inner and outer shells are welded to a 10.1-cm thick stainless steel bottom end forging. The cask bottom consists of a 7.6-cm thick, 52.71-cm diameter lead disk enclosed by a 8.9-cm thick stainless steel plate and bottom end forging. The cask lid is 28.7-cm thick stainless steel stepped design, secured to a 36.2-cm thick ring forging with twelve 2.5-cm diameter bolts. The cask lid seal is a metallic O-ring. A second teflon O-ring and a test port are provided to leak test the seal. Other penetrations in the cask cavity include the fill and drain ports, which are sealed with Alternate B port covers and metallic O-rings. A second Viton O-ring and test port are provided on each Alternate B port cover to leak test the metallic seal.

Contents:

Up to three SNL irradiated DBEs as listed in Table 1.2-10 of the SARP. Each DBE must be contained in a welded stainless steel DBE Transport Canister. Characteristics of each authorized DBE content are limited to:

- DBE Weight: 450 lbs; DBE Transport Canister Loaded Weight: 1,100 lbs
- DBE Length (w/o Handling Adapters): 75 in.; DBE Transport Canister Length: 90 in.
- ^{235}U Mass per DBE: 8 kg; ^{235}U Enrichment: 94%; Activation Source Term: 15.3 Ci ^{60}Co
- Irradiation Time: 80 hours; Heat Load: 100 W; The min. cool time: 10 y

See USA/9225/B(U)F-96 (DOE), Rev. 5 for additional details and conditions of approval.

9977

USA/9977/B(M)F-96 (DOE), Rev. 0

Expiration Date: Oct. 31, 2012

Safety Analysis Report for Packaging Model 9977 B(M)F-96 S-SARP-G-00001, Revision 2, August 2007.

Contents:

Package contents are identified as Content Envelope C.1 and are defined in Table 1. The contents are in solid form as metal pieces or oxides. Contents in liquid form are not permitted.

The total content mass listed in Table 1 excludes material containers and packing materials (i.e., RTG containers, springs, cups and union).Contents containers and content-specific configuration requirements are listed in Sections 1.2.2.1 and 1.2.2.2 of the SARP.

Description:

The 9977 is designed to ship radioactive contents in assemblies of Radioisotope Thermoelectric Generators (RTGs) or arrangements of nested food-pack cans. The components of the package include the drum, insulation, Containment Vessel (CV), Load Distribution Fixtures (LDFs), and Contents containers. The maximum weight of the packaging is 250 Ibs, with a maximum payload of 100 Ibs, and a maximum gross weight of 350 Ibs.

See USA/9977/B(M)F-96 (DOE), Rev. 0 for additional details and conditions of approval.

Steel Banded Wooden Shipping Containers, Models G-4214, G-4255, G-4273 (photo shown left), and G-4292

USA/5467/AF-85 (DOE) Rev. 23

Expiration Date: Nov. 30, 2012

Steel Banded Wooden Shipping Containers, HNF-SD-TP-SARP-019, Rev. 0, Dec. 2000.

Description:

The Steel Banded Wooden Shipping Containers (SBWSC) are used to package unirradiated uranium metal enriched to a maximum of 1.256 wt% ^{235}U in the form of billets, ingots, derbies, and scrap. The SBWSC are wooden boxes strengthened with horizontal and vertical steel bands. There are two classes of containers: 1) a box with a cover, and 2) a pallet with an inverted box as the cover. SBWSC Model numbers G-4214 and G-4292 are boxes with covers and G-4255 and G-4273 are pallets with inverted boxes as the covers.

The steel bands used on all the SBWSC are 3.18 cm (1 114 in.) wide with a minimum tensile strength of 30,025 N (6750 lb.). The steel bands meet the requirements of ASTM D 3953 and are closed with notched seals. All SBWSC are mounted on two or three wooden skids to allow handling via fork lifts.

Contents:

- New Production Reactor Ingots
- FERMCO Inqot Sections
- FERMCO Primary Ingots
- FERMCO Derbies
- Hanford RMI Billets
- FERMCO Scrap
- RMI Forged Billets
- Mark 15 Ingots and FERMCO Product Ingots

Each SBWSC must be weighed after loading and closing and shall not exceed the following gross weights:

G-4214 (572 kg); G-4255 (664 kg); G-4273-5 (1370 kg); G-4273-6 (1647 kg); G-4292 (604 kg)

See USA/5467/AF-85 (DOE), Rev. 23 for additional details and conditions of approval.

9975

USA/9975/B(M)F-96 (DOE), Rev. 0

Expiration Date: June 30, 2013

Safety Analysis Report for Packaging Model 9975, B(M)F-96, S-SARP-G-00003, Revision 0, January 2008.

Description:

The components of the package include the drum, insulation, bearing plates, primary containment vessel (PCV), secondary containment vessel (SCV), lead shielding, and aluminum honeycomb spacers. An aluminum PCV sleeve or 3013 top and bottom spacer may be used, depending on the type of product can to be transported. The nominal net weight of the packaging ranges from 159-1 68 kg. The drum is fabricated as a 132-liter (35-gallon) bolted lid drum of 18-gauge Type 304L stainless steel. Four 1.3-cm diameter vent holes are drilled into the drum, approximately 90 degrees apart, 2.5 cm below the drum flange and are covered with plastic Caplugs (fusible plugs). The plugging devices prevent water from entering the drum through the vent holes under normal conditions of transport. In the event a fire occurs, the plugs melt, allowing the drum to vent gases generated from the insulation to prevent rupture of the drum. The drum lid is bolted to a 3.2-cm wide by 0.3-cm thick angle flange welded to the top of the drum body using 24 1.3-cm high-strength bolts. The lid is recessed 1.4 cm. A 0.3-cm thick by 3.2-cm wide circular ring is welded to the outer section of the lid. The ring serves to reinforce the lid and prevents the lid from shearing away from the bolts during a hypothetical accident condition event. Nuts are tack welded to the flange underside to ease assembly operations. The bolts are tightened to 40.7 ± 2.7 N-m (30 ± 2 ft-lbs) of torque. See USA/9975/B(M)F-96 (DOE) for additional details.

Contents:

(i) Uranium metal or oxide as specified in Content Envelope C.1;
(ii) Plutonium-238 heat sources as specified in Content Envelope C.2;
(iii) Plutonium and/or uranium metal as specified in Content Envelope C.3;
(iv) Plutonium and/or uranium oxide as specified in Content Envelope C.4;
(v) Plutonium composites as specified in Content Envelope C.5;
(vi) Plutonium/tantalum composites as specified in Content Envelope C.6;
(vii) Plutonium-238 oxide/beryllium metal as specified in Content Envelope C.7;
(viii) Neptunium oxide as specified in Content Envelope C.8.

See USA/9975/B(M)F-96 (DOE), Rev. 0 for additional details of Content Envelop C.1 to C.8 in Table 1 and conditions of approval.